observations only. One feels that the theory of errors has not been grasped with a complete mastery. After glancing at such uncomfortable-looking formulæ as $BC' = d \tan (BAC + 0{\cdot}000069\, d)$ and wondering whether there is any advantage in such forms of expression as cos. of co-dec., in place of the more familiar Sin. dec., we turn to the section on longitude determination to learn how the method is practised by civil engineers and surveyors. And in this chapter one learns some strange things. It does not appear to be at all necessary to take into account the parallax of the moon in the method by lunar distances, and the problem of "clearing the distance," a problem fraught with much pain and anxiety to many, does not seem to trouble engineers and surveyors. Similarly, the longitude by lunar occultations is treated with equal lightness and brevity. We are told that the Greenwich mean times of the occultations of fixed stars by the moon are given in the *Nautical Almanac* for both immersion and emersion, and that by applying the approximate longitude in time, the approximate local mean time of the occultation may be found, and the observer will know approximately when to begin to observe. We recommend the two or three pages of explanation of the section "Elements of Occultation" given at the end of the *Nautical Almanac* to the author's attention.

These remarks are not made in any unkind spirit, but, if possible, to warn the student to what extent he may trust his author. We can readily believe that with his chain and his theodolite, the writer of the book has done, and will continue to do, good work, and if he had been content to describe accurately what he knew thoroughly, he would have given us a valuable practical treatise. But he has ventured on subjects of which his experience has not qualified him to treat, and in these directions we can neither follow him with satisfaction nor unreservedly recommend his book to the careful study of the large class of students who might have profited by it.

W. E. P.

PROTOZOAN NATURAL HISTORY.

Faune Infusorienne des Eaux stagnantes des Environs de Genève. Par Dr. Jean Roux, Assistant au Laboratoire de Zoologie de l'Université de Genève. Pp. 148; 8 plates. (Genève: H. Kundig, 1901.)

Faune Rhizopodique du Bassin du Léman. Par Dr. Eugène Penard. Pp. 714. (Genève: H. Kundig, 1902.)

THE systematic study of the natural history of the Protozoa in past years has, in general, lagged far behind that of the higher groups of animals. In large part, no doubt, this has been due to technical difficulties of collection and examination, but it has resulted also from a delay in recognition of the fact that the same problems of species and of their geographical distribution which have stimulated and directed the detailed study of Metazoan natural history for so many years have equivalent applicability and interest among the Protozoa. The brilliant labours of Ehrenberg, however, who concerned himself largely with the local distribution of Protozoan forms, and the later work of Bütschli, have been increasingly fruitful. The conception by Bütschli of the "cosmopolitanism" of the Protozoa has been supported by the results of numerous workers in various countries and continents, and found its fullest sanction in the studies of Schewiakoff during his voyage round the world. Schewiakoff, indeed, by showing in how large a proportion the Protozoan species already well known in Europe were spread through other continents, opened the most attractive field for the study of the problem of species among the unicellular animals.

The two valuable monographs we now owe to Drs. Roux and Penard will rank high among the later contributions to the Protozoan natural history. Concerned as they are with the exact description of a purely local fauna, they may be considered to be in a sense complementary to the extensive researches of Schewiakoff—they have a value which is intensive, rather. With the general idea of Protozoan ubiquity and specific "cosmopolitanism" well grounded, we may hope that by the sufficient accumulation of exact local studies, and perhaps in no other way, we may eventually see unravelled the intricate relationships of nutritive conditions and of the environment in general, not only to secondary body characters, but to the processes of fission and its secondary developments, which determine to so large a degree the life-histories of the Protozoa. Not the morphologist alone, but the physiologist too, will welcome the advances of our knowledge in this direction, for the latter must hope to gain a widely increased outlook upon the significance and origin of many cellular processes by the determination of the phylogenetic relationships among groups of Protozoa.

Dr. Jean Roux has collected, identified and described in detail the species of Infusoria occurring in the stagnant waters, in pools, marshes and basins in the neighbourhood of Geneva. His work gives fresh verification, if any were required, to the very generalised distribution of Protozoa throughout the world, for he has already found in his own district three-fifths of all the forms of non-marine Infusoria which have been described for other countries. His arrangement of the species follows Bütschli's classification, except in the order Holotricha, in which the divisions of Schewiakoff are adopted. Very complete systematic descriptions are given of every form, the arrangement and shape of its organs, its characteristic movements, and, in most cases, its normal *habitat* and mode of nutrition.

The text is illustrated by well executed coloured plates, which give figures, drawn by the author, of about 170 species. Some interesting points are raised by Dr. Roux in connection with the seasonal changes of population among the Infusoria. Statistical inquiry has shown that the population of a given species exhibits maxima and minima of seasonal incidence. In general, a maximal population is found both in spring and autumn, a fact which has not yet received adequate explanation. These two maxima may be real; they may be due to increased reproductive activity both in preparation for, and in con-

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sequence of, the encystment or quietude of the winter, or they may result from an improved food supply dependent upon similar seasonal maxima in the population of Algæ and Diatoms. The maxima, on the other hand, may be only apparent, and exhibited relatively only to a summer minimum which may be supposed to coincide with the maximal development of the natural enemies of the Infusoria, such as the crustacean Cyclops and the like. These difficulties of explanation may be taken to represent only one set out of many problems in natural history which the systematic study of these lowly forms is likely to suggest.

The appearance of Dr. Penard's companion monograph upon the Rhizopod forms of the same locality is very aptly timed. It contains the results of his laborious researches into the very numerous and often ill-defined species of this large group, with the fullest systematic descriptions of their structure and habits, and it is abundantly illustrated throughout with accurate drawings. The author has not included among the Rhizopoda the group Heliozoa, generally, but not very suitably, associated with them. Dr. Penard has already published studies of the Rhizopoda he has found elsewhere in Europe and in North America, and it is significant, in connection with what has been said above, that in his collections of purely local forms in the Genevan district he finds represented no less than 92 per cent. of the species which have been described for the whole world, although he has added a few hitherto undescribed species to the list. In this estimate, he does not include, it should be said, those forms of the Amœba class which are entirely devoid of skeleton and less easily defined or identifiable. The volume contains a large bibliography, and indices both to the subject-matter and to the species described.

In addition to the systematic description of the Rhizopod fauna, Dr. Penard gives a series of separate essays upon special points of interest in their general morphology and behaviour—he deals with their growth, the skeleton and its appendages, with the plasma, its inclusions and pseudopodia, the nucleus, the contractile vacuole, and finally with general questions of geographical distribution, reproduction and hybridity. The most important variations of the shape and disposition of the nucleus throughout the group are described and figured, and these are strikingly numerous and diversified. The author does not, however, give any systematic account of the distribution within the Rhizopoda of the chief Protozoan types of nuclear division. It has already been shown by Schewiakoff and others that complexity in the process of karyokinetic nuclear division is by no means exhibited only by the more highly organised forms among the Protozoa, and a good deal of light might be expected to be thrown upon the relationships between cellular elaboration and the karyokinetic figure by a systematic examination of the nuclear behaviour throughout the species of one group. Much no doubt remains to be done, but Dr. Roux and Dr. Penard are to be congratulated alike upon very notable achievements of skill and industry. Their labours have borne fruit already, and will long, we believe, remain profitable to fellow-workers in the same field.

A NEW ATLAS OF THE ATLANTIC OCEAN.

Atlantische Ozean. Ein Atlas von 39 Karten, die physikalischen Verhältnisse und die Verkehrs-strassen darstellend. Zweite Auflage. Herausgegeben von der Direktion. Deutsche Seewarte. (Hamburg: L. Friederichsen und Co., 1902.)

TOWARDS the end of the year 1898, the Deutsche Seewarte published the second edition of its well-known "Segelhandbuch" for the Atlantic Ocean, but it was regretted at the time by the director, Prof. Neumayer, that a new edition of the atlas was not forthcoming. There were, however, very good grounds for its non-appearance, since it was considered that there was not sufficient new material available to make it worth while undertaking such a large piece of work.

During the many years that have now elapsed since the first edition of this atlas was published, a very considerable amount of valuable information has been accumulated, and advantage is now taken to bring the atlas up to date and to make it complete and trustworthy as regards every piece of information it conveys.

Among some of the sources of the new data which have been embodied in the work is that of the valuable series of observations made by the *Valdivia*. Further, advantage has been taken of another large piece of work which has recently been brought to a conclusion, namely, the ten-degree square investigation of the North Atlantic; these observations covered a zone extending from 20° to 50° north latitude and stretching from the west of Europe to the east of North America, and they have been published recently in no less than nineteen volumes.

Another store of valuable data was also ready at hand, namely, that which had been collected by the Deutsche Seewarte in connection with the Danish Meteorological Institute and utilised for making its synoptic weather charts. The work also of our own Meteorological Office and Hydrographic Department has also been usefully employed on many occasions, and especially to fill up gaps not covered by German observations.

It will be seen that there was no lack of good material, and Prof. Neumayer has so marshalled his facts that he has been able to present seafaring men and meteorologists with a trustworthy series of maps which illustrate our present knowledge of the mean physical and hydrographical conditions of this important region of the world.

The thirty-nine maps that compose this atlas are accompanied by clear explanatory remarks which describe their mode of construction and include the sources of all the data that are contained in them.

In a brief notice, it is not possible or even necessary to describe each of the maps in this atlas, but it will suffice to remark that they are arranged, not only to give the mean meteorological, hydrographical, &c., condition for the year, but the mean, in many cases, for important individual months or groups of months.

Thus, for instance, in the case of barometric pressure, we have a chart showing the mean isobars of the Atlantic Ocean for the whole year and four maps for

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